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SCENIC LANDFORMS OF VIRGINIA

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Virginia has a wide variety of scenic landforms, such as mountains, waterfalls, gorges, islands, water and wind gaps, caves, valleys, hills, and cliffs. These landforms, some with interesting names such as Hanging Rock, Devils Backbone, Striped Rock, and Lovers Leap, range in elevation from Mt. Rogers at 5729 feet to Assateague and Tangier islands near sea level. Two natural lakes occur in Virginia, Mountain Lake in Giles County and Lake Drummond in the City of Chesapeake. Gaps through the mountains were important routes for early settlers and positions for military movements during the Civil War. Today, many gaps are still important locations of roads and highways.

For this report, landforms are listed alphabetically by county or city. Features along county lines are described in only one county with references in other appropriate counties. The explanation of each feature includes its index number (Map; Pages 28 and 29); its name; the 1:24,000-scale topographic map depicting its location and surroundings; a brief description, its accessibility, and the age and type of rock involved; and a reference for additional geological information. Most of these references and all of the topographic maps can be ordered from the Virginia Division of Mineral Resources' sales office or can be seen in the Division's library in Charlottesville. Waterfall heights in the Shenandoah National Park are from those listed by Wissinger and Carter (1986); other heights are from national forest or Blue Ridge Parkway sources or from the authors cited. Highways and trail routes are abbreviated as USI - U. S. Interstate, USH - U. S. Highway, SH - State Highway, SR - State Road, GWNFR(T) - George Washington National Forest Road (Trail), JNFR(T) - Jefferson National Forest Road (Trail), BRPMP - Blue Ridge Parkway mile post, and SNPMP - Shenandoah National Park mile post.

This listing is primarily of those landforms named on topographic maps. It is hoped that the reader will advise the Division of other noteworthy landforms in the State that are not mentioned. *For those features on private land always obtain the owner's permission before visiting.* Some particularly interesting features are described in more detail below.

Dismal Swamp (see Chesapeake, City of)

The Dismal Swamp, located in southeastern Virginia, is about 10 to 11 miles wide and 15 miles long, and extends southward into North Carolina (Figure 1).

Figure 1. Dismal Swamp.

Much of it is in the Great Dismal Swamp National Wildlife Refuge. Its surface slopes gently eastward at about 1 foot per mile. Lake Drummond, the largest natural lake in Virginia, is located near the center of the Swamp. The lake has an oval shape of about 2 to 3 miles in diameter. Access ditches were constructed both from the east and west during Colonial time to market the timber resources. It is underlain by Quaternary peat (with a thickness up to 13 feet), sand, and clay. The swamp was extensively ditched from 1959 to 1962 for better drainage, access, and fire control. (Oaks and Coch, 1973)

Mountain Lake (see Giles County)

Mountain Lake, one of two natural lakes in Virginia, is in a high saddle on Salt Pond Mountain at an elevation of 3875 feet. The lake is about 0.75 mile long and, 0.25 mile wide, and has a maximum depth of 75 feet (Figure 2). It is located in a valley formed by a breached anticline where streams have eroded through the Silurian Tuscarora sandstone into Ordovician age Juniata sandstone and Reedsville shale and limestone. The lake is drained at its northwest end by Pond Drain through a natural dam of large sandstone blocks with intermixed shale. This dam was probably formed by a rockslide. Records indicate that a lake has been here since 1751 but with various amounts of water due to climatic conditions. A hotel is located at the lake. (Sharp, 1936; Schultz and others, 1986)

Natural Bridge (see Rockbridge County)

This large rock arch has been viewed by thousands as a unique natural feature (Figure 3). Cedar Creek flows under the arch and U. S. Highway 11 is routed across its top. It was owned by Thomas Jefferson in the late 1700s. The bottom of the arch is 150 feet above Cedar Creek. The arch ranges from 37 to 94 feet thick, is 50 to 150 feet wide and about 90 feet long. The arch spans the incised canyon of Cedar Creek. Natural Bridge is composed of massively-bedded, sandy dolomite of the Ordovician Beekmantown Formation which overlies, in the bottom of the canyon, limestone of the Chepultepec Formation. The arch is located along the axis of a syncline with bedding inclined toward the arch.

The origin of Natural Bridge is explained as the "unroofing" of a subterranean cave extending toward the James River. The arch has survived erosion because of the presence of thick, flat-lying dolomite beds. Fractures in the inclined rocks along the canyon walls have made these rocks more susceptible to erosion, due to forces exerted by freezing water. The canyon is deeply incised. Erosion probably was accelerated by the increase in water flow due to the diversion or "capture" of other streams west of Natural Bridge by the ancestral course of Cedar Creek. A hotel is located at the Bridge. (Spencer, 1968, 1985)

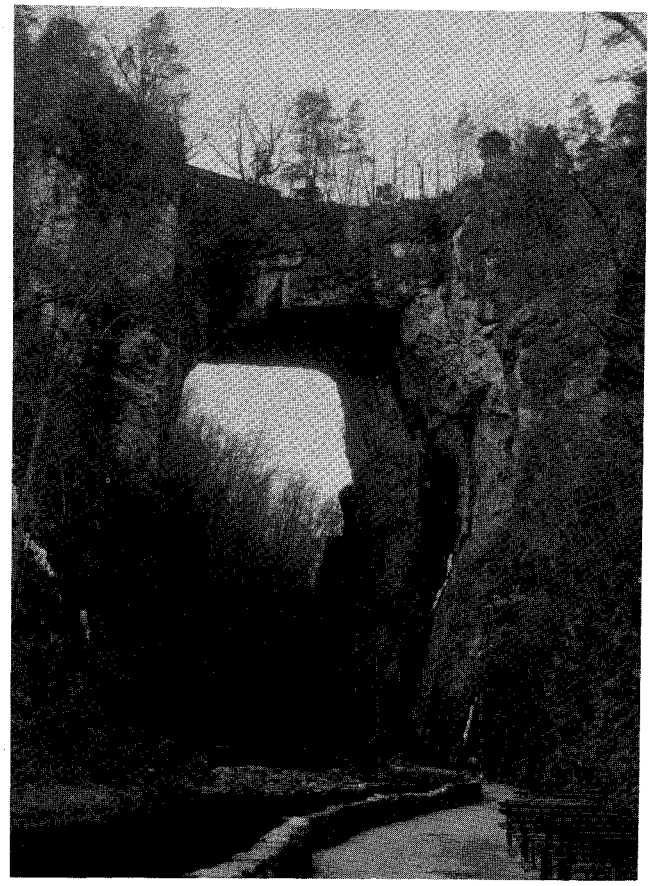


Figure 3. Natural Bridge.

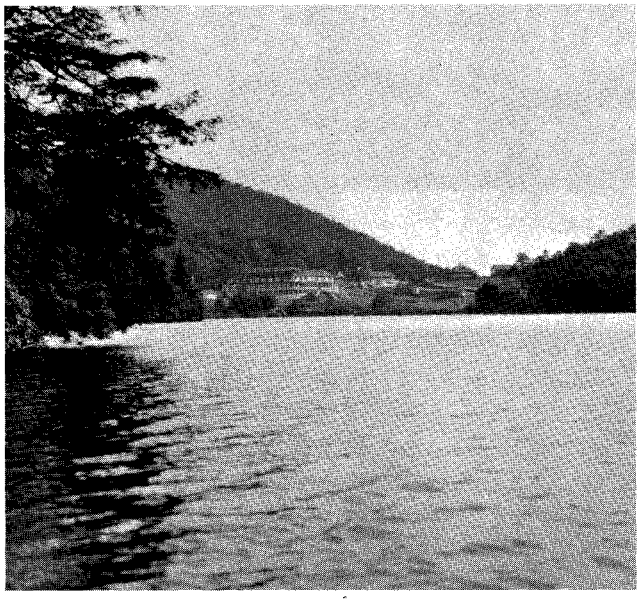


Figure 2. Mountain Lake.

Natural Chimneys (see Augusta County)

Natural Chimneys is a series of rock towers that rise as much as 120 feet above the adjacent floodplain of North River (Figure 4). They are composed of horizontally-bedded Cambrian Conococheague dolomite and limestone and crop out along the axis of a syncline. The shapes of the columns are the result of erosion along vertical joints. Several columns have solution tunnels at their bases. The towers are in Natural Chimneys Regional Park, where camping is available. (Rader, 1969)

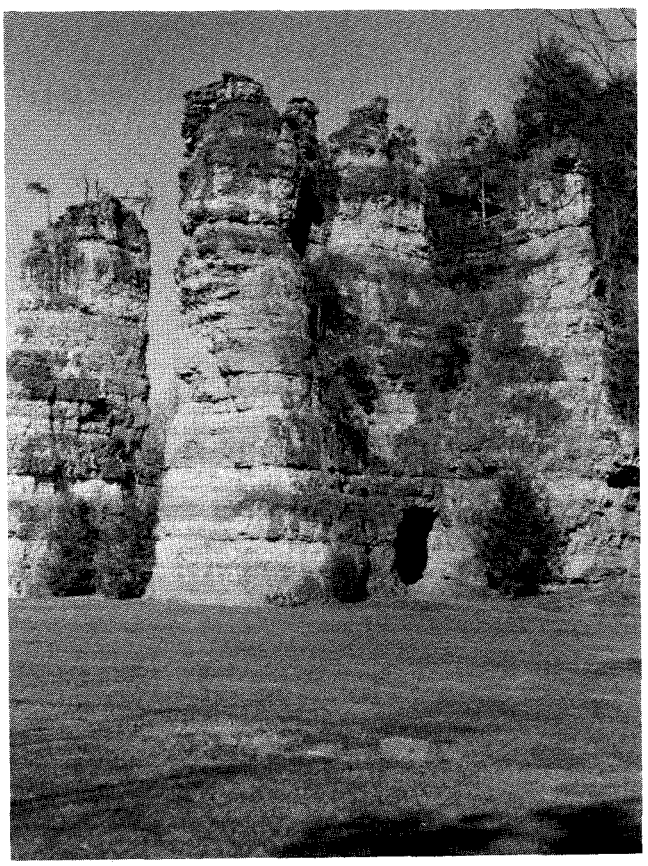


Figure 4. Natural Chimneys.

Natural Tunnel (see Scott County)

Natural Tunnel is a large solution arch in the Ordovician Chepultepec, Longview, and Kingsport dolomites (Figure 5). Stock Creek and the Norfolk Southern Railway System route pass through it. The tunnel is about 900 feet long, has a width of up to 175 feet and has a height above the creek of about 100 feet. Lovers Leap overlook on the east side of the tunnel is some 450 feet above the creek. To the south of the tunnel Stock Creek flows in a gorge up to 700 feet deep. The tunnel is now a part of Natural Tunnel State Park. (Brent; 1963, Holsinger, 1975)

Figure 5. Natural Tunnel.

The Breaks (see Dickenson County)

The Breaks consist of a narrow deeply-incised, sinuous valley of the Russell Fork River. Steep cliffs rise to about 1000 feet above the river, some with eroded fanciful shapes named Lovers Leap, The Towers (Figure 6), the Chimney, and the Notches. The CSX Transportation, Inc. railroad is routed along the river. The Breaks and a large area on the east side of the river are in Breaks Interstate Park. The park is underlain by a broad anticline of Pennsylvanian Lee and Breathitt conglomeratic sandstone and coal. The river course appears to follow zones of weakness due to structurally produced fractures. (Alvord and Miller, 1972)

General references to the geological and topographic features of the State available from the Division are: "Geology and Virginia" (Dietrich, 1970), "Roadside Geology of Virginia" (Frye, 1986) and "Geographic and Cultural Names of Virginia" (Biggs, 1974).

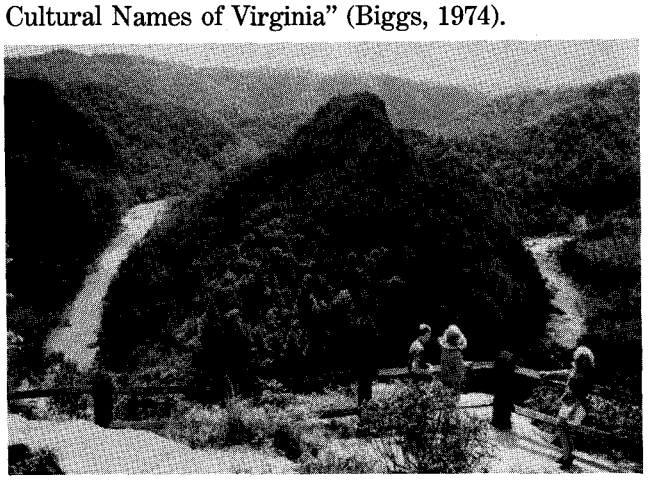


Figure 6. The Breaks.

County/City	No.	Name/*(Topographic Map)*/Description
Accomack	1	Assateague Island *(Chincoteague East, Chincoteague West, Boxiron)* Offshore barrier island with sand dunes to 50′ high and tidal marshes and bays located in Assateague Island National Seashore by SH175; Holocene sand (Mixon, 1985)
	(97)	Chesapeake Bay *(see Northampton County)*
	2	Tangier Island *(Tangier Island)* Large island in Chesapeake Bay accessible by boat from Reedville or Onancock; Holocene sand and mud (Mixon, 1985)
Albemarle	3	Black Rock *(Browns Cove)* Rocky summit on Blue Ridge with view to west by fire road and trail between SNPMP 84 and 85; Cambrian Harpers quartzite (Gathright, 1976)
	4	Doyle River Falls *(Browns Cove)* Two waterfalls on Doyles River of 28′ and 63′; by trail between SNPMP81 and 82; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	5	Jones Run Falls *(Browns Cove)* Waterfall on Jones Run of 42′; by trail between SNPMP84 and 85; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	6	Rivanna River water gap *(Charlottesville East)* Water gap of Rivanna River between Southwest Mountains and Carter Mountain traversed by CSX Transportation, Inc. railroad; Precambrian-Cambrian Catoctin metabasalt (Nelson, 1962)
Allegheny	7	Beaverdam Falls *(Allegheny)* Waterfall on Sweet Spring Creek at confluence with Dunlap Creek near SR603; Devonian Brallier sandstone, siltstone, and shale (Milici and others, 1963)
	8	Falling Springs *(Covington)* Waterfall (Figure 7) of about 70′ on Falling Spring Creek visible from USH220; Silurian Rose Hill sandstone (Rader and Gathright, 1984)

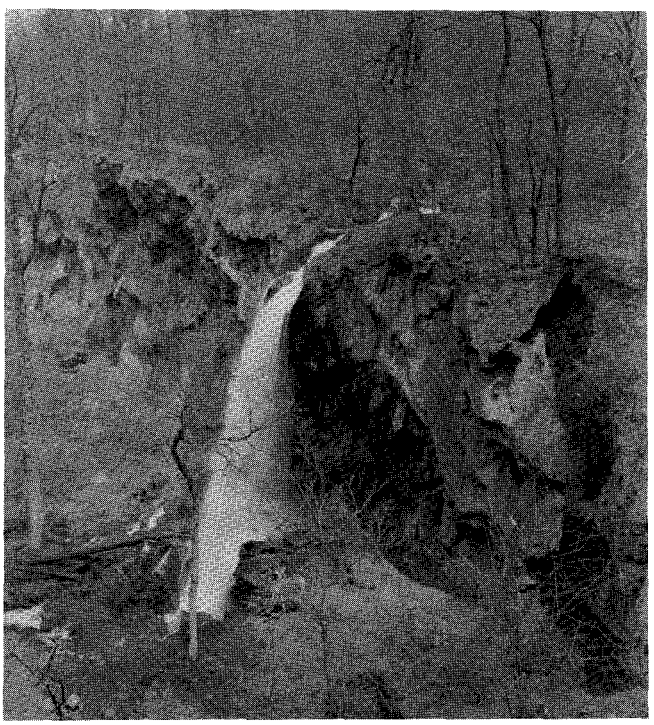


Figure 7. Falling Springs Falls.

Figure 8. Rainbow Gap.

County/City	No.	Name/*(Topographic Map)*/Description
	9	Rainbow Gap *(Clifton Forge)* Water gap of Jackson River through Rich Patch Mountain (Figure 8), traversed by USH220; Silurian Tuscarora, Rose Hill, and Keefer sandstones and a faulted anticline visible on east side of gap (Lesure, 1957)
Amherst	10	Humphreys Gap *(Buena Vista)* Windgap in Blue Ridge crossed by USH60; Cambrian Unicoi sandstone (Bloomer and Werner, 1955)
	11	James River gorge *(Snowden)* Sinuous gorge of James River through the Blue Ridge, traversed by USH501; Cambrian Antietam, Harpers, and Unicoi sandstone and shale to west and Precambrian granite and gneiss to east (Bloomer and Werner, 1955; Brown and Spencer, 1981)
Augusta	12	Big Levels *(Big Levels)* Flat-topped mountain visible from USH340; Cambrian Antietam sandstone (Werner, 1966)
	13	Buffalo Gap *(Churchville)* Water gap of Buffalo Branch in Little North Mountain traversed by SH42; Silurian sandstone (Rader, 1967)
	14	Calvary Rocks *(Crimora)* Cliffs on Rocks Mountain with view of Shenandoah Valley by trail from SNPMP90; Cambrian Antietam quartzite with *Skolithus* fossils (Gathright and others, 1978b)
	15	Grand Caverns *(Grottoes)* Commercial cavern at Grottoes in Grand Caverns Regional Park; Cambrian Conococheague limestone (Gathright and others, 1978a)
	16	Mary Gray and Betsy Bell *(Staunton)* Pair of rounded hills at Staunton visible from USH250; Ordovician Beekmantown cherty dolomite and limestone (Rader, 1967)
	17	Natural Chimneys *(Parnassus)* See detailed description on page 23
	18	Rockfish Gap *(Waynesboro East)* Windgap in Blue Ridge crossed by USI64 and USH250; Precambrian-Cambrian Catoctin metabasalt (Gathright and others, 1977)
	19	Round Hill *(Stuarts Draft)* Conical-shaped hill visible from USH340; Ordovician Beekmantown cherty dolomite and limestone (Rader, 1967)

County/City	No.	Name/*(Topographic Map)*/Description
	20	The Rocks *(Sherando)* Peak on Humpback Mountain with panoramic view of the Blue Ridge and Shenandoah Valley, by Appalachian Trail from BRPMP6; Precambrian-Cambrian Catoctin metabasalt (Bartholomew, 1977)
Bath	21	Blue Suck Falls *(Healing Springs)* Waterfall with trail access in Douthat State Park; flows over Silurian Keefer sandstone and quartzite (Waag, 1964)
	(69)	Bullpasture Gorge *(see Highland County)*
	22	Panther Gap *(Green Valley)* Watergap of Mill Creek through Mill Mountain, traversed by SH39 and 42; Silurian sandstone and quartzite with anticlinal and synclinal folding (Bick, 1962)
	23	Richardson Gorge *(Mountain Grove)* Gorge of Jackson River, traversed by SR603; Devonian limestone and sandstone (Milici and others, 1963)
	24	Warm Springs Valley *(Healing Springs, Warm Springs Run)* Valley enclosed by mountains, traversed by USH220; breached anticline with Ordovician limestone and hot springs in a valley bounded by mountains of Silurian sandstone and quartzite (Rader and Gathright, 1984)
Bedford	(11)	James River gorge *(see Amherst County)*
	(114)	Gap of Smith Mountain *(see Pittsylvania County)*
	25	Peaks of Otter *(Peaks of Otter)* Two mountains (Figure 9) Sharp Top (3862′) and Flat Top (3994′) by trails from BRPMP84; Precambrian Blue Ridge Complex granite and gneiss (Milici and others, 1963)
	26	Roanoke River watergap *(Stewartsville, Hardy)* Watergap of Roanoke River through Blue Ridge Mountains traversed by Norfolk Southern Railway System; Precambrian gneiss and Cambrian Weverton phyllite and meta-sandstone (Milici and others, 1963; Bartholomew, 1981)
Bland	27	South Gap *(Rocky Gap)* Watergap of Wolf Creek between Wolf Creek and Rich Mountains traversed by IH77; Silurian and Ordovician sandstone and shale (Milici and others, 1963)
Botetourt	28	Apple Orchard Falls *(Arnold Valley)* Waterfalls on North Creek tributary by JNFT from SR812; Precambrian Virginia Blue Ridge Complex granite (Spencer, 1968)
	29	Cascades *(Peaks of Otter)* Waterfalls on Fallingwater Creek by trail between BRPMP83 and 84; Precambrian Blue Complex of granite and gneiss (Milici and others, 1963)
	30	Eagle Rock *(Eagle Rock)* Watergap of James River between Rathole and Crawford Mountains with highly folded and faulted Silurian Tuscarora, Rose Hill, and Eagle Rock quartzite and sandstone (Rader and Gathright, 1986)
	31	James River *(Clifton Forge)* Confluence of Jackson and Cowpasture rivers to form James River near Iron Gate; Devonian Romney shale (Lesure, 1957)
	32	Roaring Run Falls *(Strom)* Waterfall on Roaring Run by GWNFT from Recreation Area (with iron furnace) near SR621; Silurian Keefer sandstone (McGuire, 1970)
Buckingham	33	Geographic Center of Virginia *(Buckingham)* Near descriptive marker at junction of SH24 and USH60; Paleozoic meta-gabbro (Ern, 1968)
	34	Willis Mountain *(Willis Mountain)* Isolated mountain (Figure 10) visible from USH15; Ordovician Arvonia kyanite quartzite and schist (Marr, 1980)
Campbell	35	Candler Mountain *(City Farm)* Linear mountain near Lynchburg crossed by SR670; Precambrian Paleozoic Candler phyllite and schist (Brown, 1958)
Carroll	36	Fancy Gap *(Fancy Gap)* Windgap in Blue Ridge crossed by USH52; Precambrian-Paleozoic Alligator Back gneiss with fault (Espenshade and others, 1975)
Chesapeake, City of	37	Lake Drummond *(Lake Drummond)* See detailed description in Dismal Swamp on page 21
	38	Dismal Swamp *(Deep Creek, Lake Drummond NW, Lake Drummond SE, Bowers Hill, Norfolk South)* See detailed description on page 21
Clarke	39	Ashby Gap *(Ashby Gap)* Windgap in Blue Ridge crossed by USH17 and 50 in Precambrian-Cambrian Catoctin metabasalt (Gathright and Nystrom, 1974)
	40	Snickers Gap *(Bluemont)* Windgap in Blue Ridge crossed by SH7; Precambrian-Cambrian Catoctin metabasalt (Parker, 1968)
Craig	41	Meadow Creek Falls *(Looney)* Waterfall of Meadow Creek adjacent to SR42 *on private land;* Silurian sandstone and quartzite (Milici and others, 1963)

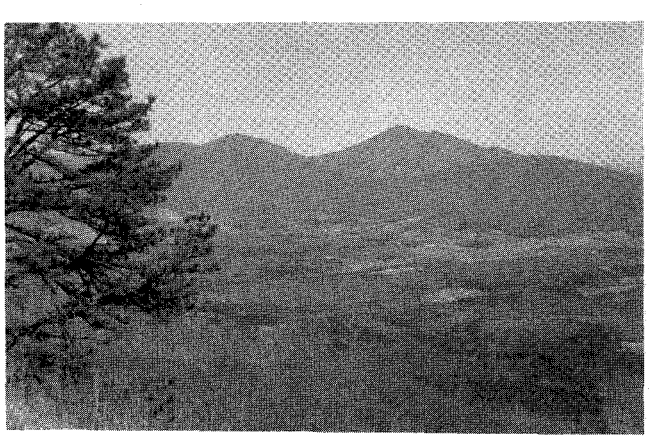


Figure 9. Peaks of Otter.

Figure 10. Willis Mountain.

County/City	No.	Name/*(Topographic Map)*/Description
	42	Sinking Creek Valley *(Looney, Craig Springs, Newport)* Linear valley rimmed by Sinking Creek and Johns Creek mountains traversed by SH42; Ordovician limestone in valley bounded by mountains of Silurian sandstone and quartzite (Milici and others, 1963)
Culpeper	43	Buzzard Mountain *(Rapidan)* Twin isolated oblong-shaped mountains adjacent to SR615; Triassic-Jurassic diabase intrusives (Lee, 1980)
	44	Mt. Pony *(Culpeper East)* Large linear mountain adjacent to SH3 and USH522; Triassic-Jurassic diabase intrusives (Lee, 1980)
Dickenson	45	The Breaks *(Elkhorn City)* See detailed description on page 23
Fairfax	46	Great Falls *(Falls Church, Seneca, Vienna)* Falls of Potomac River of about 40 feet vertically in about 600 feet across "Fall Zone" at Great Falls Park by SR738; Precambrian Paleozoic schist, metagraywacke and granite (Reed and others, 1980)
Fauquier	(39)	Ashby Gap *(see Clarke County)*
	47	Manassas Gap *(Linden)* Windgap in Blue Ridge crossed by SH55 and USI66; Precambrian-Cambrian Catoctin metabasalt (Lukert and Nuckols, 1976)
	48	Thoroughfare Gap *(Thoroughfare Gap)* Watergap of Broad Run between Bull Run and Pound mountains traversed by SH55 and USI66; Cambrian Weverton quartzite (personal communication, T. M. Gathright, II, 1988)
Floyd	49	Styles Falls *(Pilot)* Waterfall of about 50′ on Purgatory Creek by *private trail and road* from SR637; Precambrian Blue Ridge Complex granite and gneiss (Dietrich, 1959)
	50	Twin Falls *(Check)* Waterfalls on Lick Fork and its tributary of about 400′ and 500′ on *private land* with trail from SR645; Precambrian Blue Ridge Complex granite and gneiss (Dietrich, 1959)
Fluvanna	51	Bremo Bluff *(Arvonia)* Rocky cliffs adjacent to James River by SR656; Ordovician Arvonia Bremo Member quartzite (Brown, 1969)
Franklin	52	Devils Backbone *(Callaway)* Rocky ridge visible from overlook between BRPMP143 and 144; Precambrian Blue Ridge Complex granite and gneiss (Milici and others, 1963)
	53	Falling Rock Falls *(Hardy)* Fall of Prater Creek with trail from SR681 on *private land*; Precambrian Blue Ridge Complex granite and gneiss (Milici and others, 1963)
	54	Murray Gap *(Garden City)* Windgap in Blue Ridge crossed by USH220; Precambrian Blue Ridge Complex granite and gneiss (Milici and others, 1963)
Frederick	55	Mountain Falls *(Capon Springs)* Waterfalls on Fall Run of about 50′ by *private trail* from Wilde Acres; flows down dip slope of Silurian Keefer sandstone (Butts and Edmundson, 1966)
Fredericksburg, City of	(155)	Rappahannock River Falls *(see Stafford County)*
Giles	56	Angels Rest *(Narrows)* Mountain peak at elevation of 3633′ crossed by Appalachian Trail and visible from USH460; Silurian Tuscarora and Rose Hill sandstones at the apex of a syncline (Schultz and others, 1986)

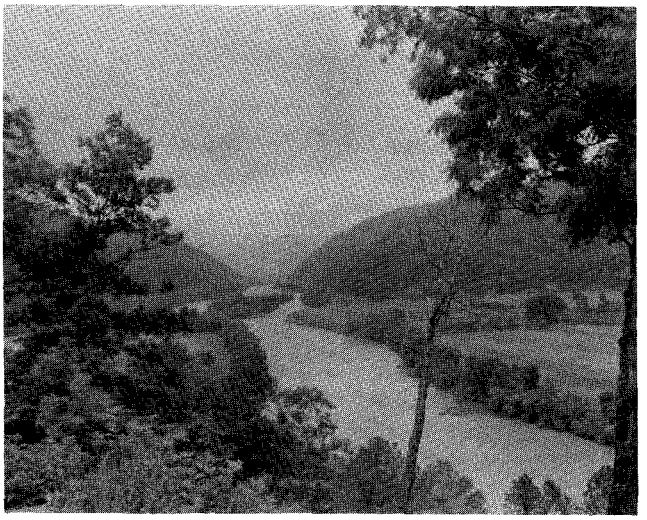


Figure 11. Narrows of New River.

County/City	No.	Name/*(Topographic Map)*/Description
	57	Cascades *(Eggleston)* Waterfall of about 70′ of Little Stony Creek by JNFT from SR623; Silurian Rose Hill sandstone (Schultz and others, 1986)
	58	Falls of Dismal Creek *(Mechanicsburg)* Waterfall of about 15′ on Dismal Creek by SR606 and JNFR2018; Silurian Keefer sandstone (Schultz and others, 1986)
	59	Mountain Lake *(Eggleston)* See detailed description on page 22
	60	The Narrows *(Narrows)* Watergap of New River (Figure 11) between East River and Peters mountains traversed by USH460; Silurian Tuscarora, Rose Hill and Keefer sandstones (Schultz and others, 1986)
Grayson	61	Comers Rock *(Speedwell)* Overlook with panoramic views of Appalachian Valley and Blue Ridge on Iron Mountains in Mt. Rogers National Recreational Area by JNFR57 from USH21; Cambrian Unicoi quartzite (Stose and Stose, 1957)
	62	Mt. Rogers *(Whitetop Mountain)* State's highest mountain at elevation of 5729′ in Mt. Rogers National Recreational Area by Appalachian Trail from SR600 or Grayson Highlands State Park; Precambrian Mt. Rogers rhyolite (Rankin and others, 1972)
	63	Striped Rock *(Elk Creek)* Cliffs on Point Lookout Mountain visible from USH21; Precambrian Striped Rock granite (Rankin and others, 1972)
	(154)	Whitetop Mountain *(see Smyth County)*
Greene	64	Bearfence Mountain *(Fletcher)* Rocky mountain peak on Blue Ridge with panoramic views by trail between SNPMP 56 and 57; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	65	South River Falls *(Elkton East)* Waterfall of 83′ on South River; by trail between SNPMP 62 and 63; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	66	Swift Run Gap *(Swift Run Gap)* Windgap in Blue Ridge crossed by USH33; Precambrian Pedlar granodiorite (Gathright, 1976)

County/City	No.	Name/*(Topographic Map)*/Description
James City	67	Jamestown Island *(Surry, Hog Island)* Historic island in James River by Colonial Parkway from Williamsburg; Quaternary Poquoson sand, silt and clay with marsh and beach deposits (Berquist and others, in preparation)
Highland	68	Big Valley *(Burnsville, Mustoe, Monterey SE)* Mountain enclosed valley drained by Dry Branch and Bolar Run through watergaps; breached anticline of Ordovician limestones, dolomites and shales in valley bounded by Silurian quartzites and sandstones on the enclosing mountains (Bick, 1962)
	69	Bullpasture Gorge *(Williamsville)* Watergap of Bullpasture River between Bullpasture and Tower Hill mountains traversed by SR678; Silurian sandstones, shales, and limestones (Bick, 1962)
	70	Devils Backbone *(Monterey, Snowy Mtn.)* Rocky elongate ridge adjacent to SR642; Silurian Tuscarora sandstones and quartzite (Milici and others, 1963)
	71	Shenandoah Mountain *(West Augusta)* Windgap with overlook of Highland County mountains from USH250; Devonian Jennings sandstone and shale; rocks in overlook walls are Silurian sandstone with *Arthrophycus* fossils (Lesure, 1982)
	72	Trimble Knob *(Monterey)* Conical hill (Figure 12) visible from USH 220; Eocene basalt intrusive (Rader and others, 1986)
King William	73	York River *(West Point)* Confluence of Pamunkey and Mattaponi rivers to form York River at West Point, visible from SH33; Pleistocene Sedgefield gravel, sand and clay (Berquist and others, in preparation)
Lee	74	Cumberland Gap *(Middlesboro South)* Windgap in Cumberland Mountain crossed by USH25E; Mississippian sandstones and limestones and Pennsylvanian sandstones; Rocky Face fault crosses gap (Englund, 1964)
	75	Natural Bridge, *(Hubbard Springs)* Small natural bridge over Batie Creek about 11′ high, 49′ wide and 92′ long crossed by SR662; Ordovician Martin Creek limestone (Miller and Brosge, 1954)
	76	Pennington Gap *(Pennington Gap)* Watergap of North Fork of Powell River in Stone Mountain with USH421 and rock profile resembling human head; Pennsylvanian Lee sandstone and shale (Miller and Roen, 1973)

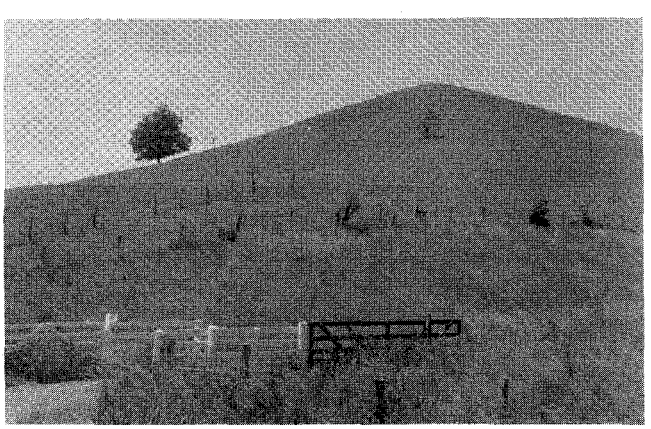


Figure 12. Trimble Knob.

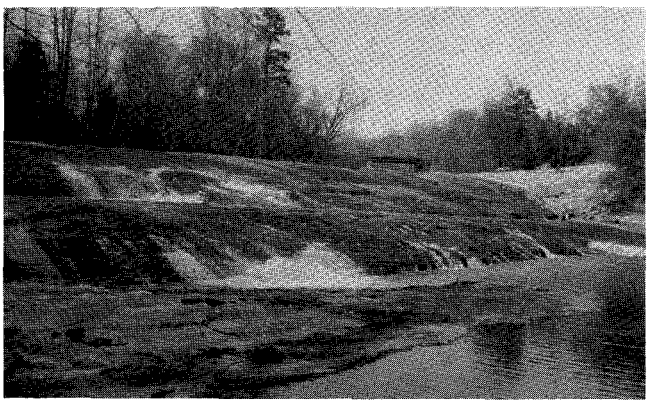
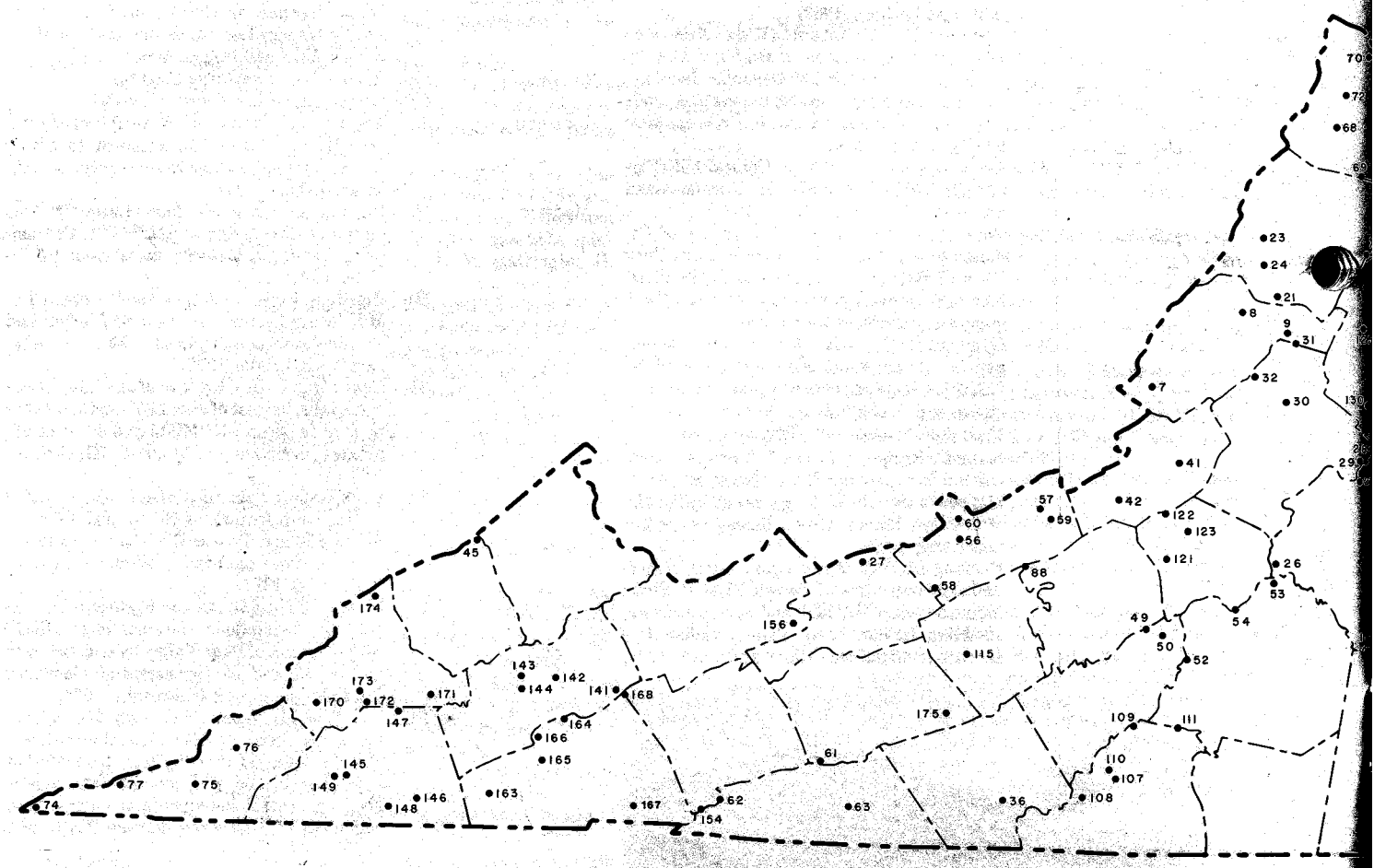
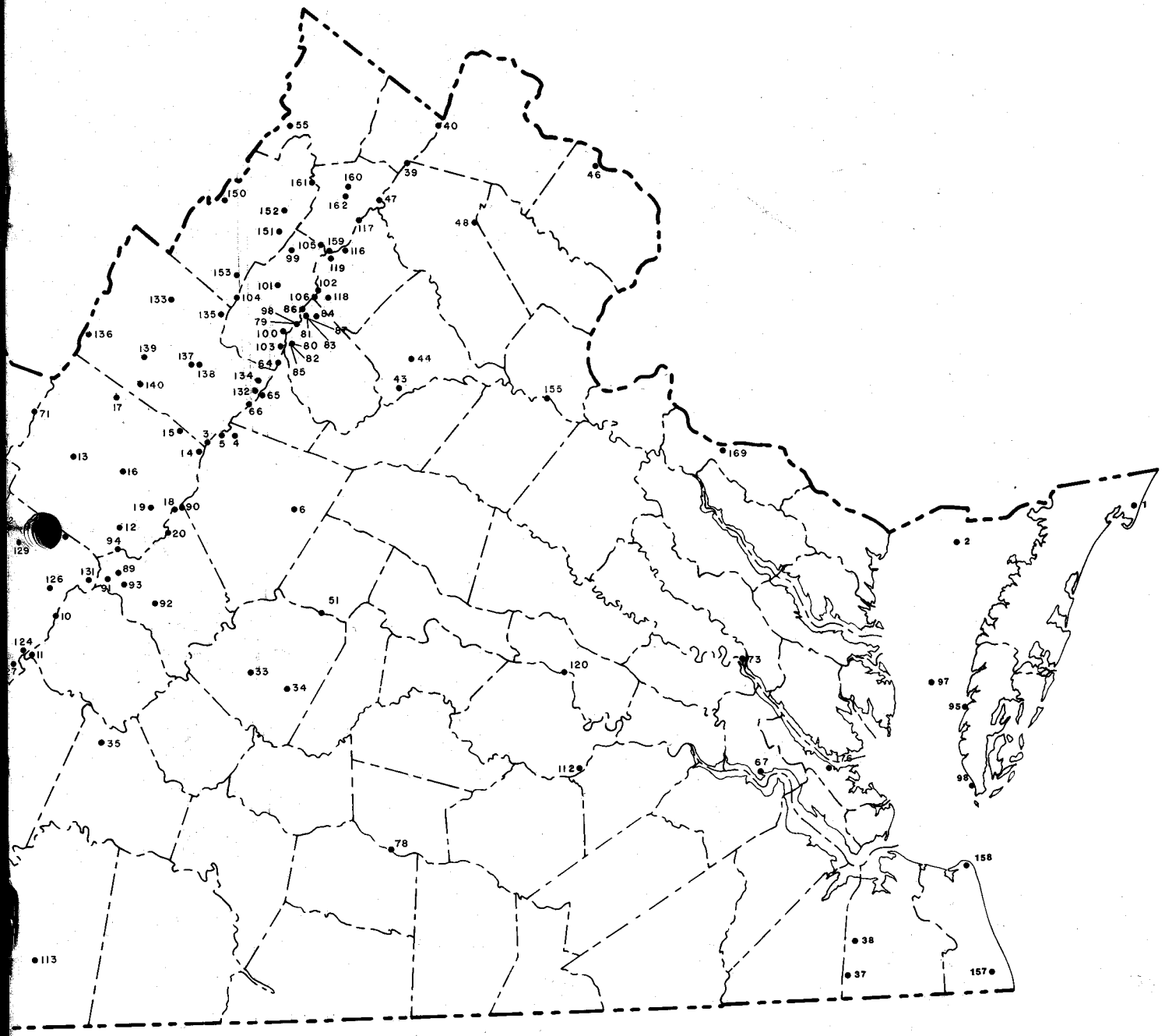


Figure 13. The Falls.

County/City	No.	Name/*(Topographic Map)*/Description
	77	White Branch Falls *(Rose Hill)* Waterfall of White Branch on Cumberland Mountain; Pennsylvanian Lee sandstone and conglomerate (Milici and others, 1963)
Loudoun	(39)	Ashby Gap *(see Clarke County)*
	(40)	Snickers Gap *(see Clarke County)*
Lunenburg	78	The Falls *(Rubermont)* Waterfall on Nottoway River (Figure 13), adjacent to SH49; Precambrian-Paleozoic Redoak granite (Milici and others, 1963)
Madison	79	Big Meadows *(Big Meadows)* Large flat area on top of Blue Ridge at SNPMP51; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	80	Big Rock Falls *(Fletcher)* Small waterfall of Mill Prong by trail between SNPMP52 and 53; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	81	Cedar Run Falls *(Old Rag Mountain)* Three waterfalls, largest of about 35′, on Cedar Run by trail between SNPMP45 and 46; Precambrian-Cambrian metabasalt (Gathright, 1976)
	82	Dark Hollow Falls *(Big Meadows)* Waterfall of Hogcamp Branch of 70′ by trail between SNPMP50 and 51 near Big Meadows Resort; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	83	Hawksbill *(Big Meadows)* Highest mountain peak in Shenandoah National Park (4050′) with overlook of Page Valley by trail between SNPMP46 and 47; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	84	Old Rag Mountain *(Old Rag Mountain)* Rocky mountain of 3268′ elevation in Shenandoah National Park by trail from SR600; Precambrian Old Rag granite with weathered spheroidal boulders and narrow passageways of weathered diabase (Gathright, 1976)
	85	Rose River Falls *(Big Meadows)* Two waterfalls of 65′ and 22′ on Rose River by trail between SNPMP49 and 50; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	86	Stony Man *(Old Rag Mountain)* Second highest mountain in Shenandoah National (4011′) with overlook of Page Valley by trail between SNPMP41 and 42 near Skyland Resort; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)



Map. Landform locations.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County/City	No.	Name/*(Topographic Map)*/Description
	87	White Oak Canyon Falls *(Old Rag Mountain)* Six waterfalls with total drop of 333′ on Robinson River tributary by trail between SNPMP42 and 43; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
Montgomery	88	Big Falls *(Radford North)* Rapids in New River at watergap between Walker and Gap mountains adjacent to SR625; Silurian sandstone and quartzite (Milici and others, 1963)
Nelson	89	Crabtree Falls *(Massies Mill)* Five waterfalls with total drop of about 500′ on Crabtree Creek by GWNFT from SH56; Precambrian Pedlar granite and granodiorite (Bloomer and Werner, 1955; Dietrich, 1970)
	(18)	Rockfish Gap *(see Augusta County)*
	90	Rockfish Valley Overlook *(Waynesboro East)* Overlook on Blue Ridge from USI64 of Rockfish Valley; Precambrian-Cambrian Catoctin metabasalt (Gathright, and others, 1977)
	91	Spy Rock *(Massies Mill)* Rocky summit with panoramic view on Maintop Mountain by Appalachian Trail from SR826; Precambrian Pedlar granite and granodiorite (Bloomer and Werner, 1955)
	92	The Falls *(Horseshoe Mountain)* Waterfall on Dillard Creek tributary by *private trail* from SR623; Precambrian Lovingston gneiss (Bloomer and Werner, 1955)
	93	The Priest *(Massies Mill)* Mountain of 4063′ elevation in GWNF by Appalachian Trail from SH56; Precambrian Pedlar granite and granodiorite (Bloomer and Werner, 1955)
	(20)	The Rocks *(see Augusta County)*
	94	Twenty Minute Cliff overlook *(Big Levels)* Overlook from Blue Ridge at BRPMP19 of North Fork Tye River ravine; Cambrian Unicoi graywacke and quartzite (Werner, 1966)
Northampton	95	White Cliffs *(Cheriton)* Sand dunes up to 20′ high adjacent to Chesapeake Bay near Smith Beach by SR666; Pleistocene Nassawadox sand (Mixon, 1985)
	96	Butlers Bluff *(Townsend)* Sand dunes up to 55′ high near Kiptopeke Beach adjacent to Chesapeake Bay near SR646; Pleistocene Nassawadox sand (Mixon, 1985)
	97	Chesapeake Bay *(Chincoteague, Norfolk, Richmond 1:250,000 scale maps)* Large estuary of former course of Susquehanna River extending southward from Maryland into Virginia and flowing into the Atlantic Ocean; visible from the Chesapeake Bay Bridge-Tunnel on USH17; Quaternary sands, silts, clays and gravels (Bird, 1985)
Nottoway	(78)	The Falls *(see Lunenburg County)*
Page	(64)	Bearfence Mountain *(see Greene County)*
	98	Franklin Cliffs *(Big Meadows)* Cliffs up to 150′ high visible at SNPMP49 overlook; Precambrian-Cambrian Catoctin metabasalt (Reed, 1969; Gathright, 1976)
	99	Goods Falls *(Rileyville)* Rapids on South Fork of Shenandoah River by SR684; Ordovician Martinsburg shales and sandstones (Allen, 1967)
	(83)	Hawksbill *(see Madison County)*
	100	Lewis Springs Falls *(Big Meadows)* Waterfall on Hawksbill Creek of 81′ with trail between SNPMP51 and 52 near Big Meadows Resort; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	101	Luray Caverns *(Luray)* Commercial cavern at Luray in Cave Hill adjacent to USH211; Ordovician Beekmantown dolomite (Hack and Durloo, 1962)
	102	Marys Rock *(Thornton Gap)* Mountain peak (3514′) in Shenandoah National Park with panoramic view of Shenandoah Valley and Blue Ridge by Appalachian Trail at junction USH220 and Skyline Drive; Precambrian Pedlar granodiorite (Gathright, 1976)
	103	Naked Creek Falls *(Fletcher)* Three waterfalls on Naked Creek with trail between SNPMP 53 and 54; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	104	New Market Gap *(Hamburg)* Prominent windgap on Massanutten Mountain crossed by USH211; Ordovician Martinsburg sandstone and shale (Allen, 1967)
	105	Overall Run Falls *(Bentonville)* Highest waterfall in Shenandoah National Park of 93′ with another of 29′ by trail from Mathews Arm Campground between SNPMP22 and 23; Precambrian-Cambrian Catoctin metabasalt (Gathright, 1976)
	(86)	Stony Man *(see Madison County)*
	106	Thornton Gap *(Thornton Gap)* Windgap on Blue Ridge crossed by USH211; Precambrian-Cambrian Catoctin metabasalt on north side in fault contact with Precambrian Pedlar granodiorite on south side (Gathright, 1976)
Patrick	107	Lover's Leap *(Stuart)* Cliffs visible from USH58; Precambrian-Paleozoic Alligator Back gneiss and phyllite (Espenshade and others, 1975)
	108	Pinnacles of Dan *(Meadows of Dan)* Erosional pinnacles adjacent to the Dan River; Precambrian-Paleozoic Alligator Back gneiss and phyllite (Espenshade and others, 1975)
	109	Rock Castle Creek Gorge*(Willis, Woolwine)* Gorge of Rock Castle Creek in Blue Ridge by road in Rocky Knob Recreation Area at BRPMP169; Precambrian-Paleozoic Alligator Back gneiss and phyllite (Espenshade, and others, 1975)
	110	Smith Mountain Falls *(Stuart)* Waterfall on Waterfall Branch *on private land;* Precambrian-Paleozoic Alligator Back gneiss and phyllite (Espenshade and others, 1975)
	111	White Falls *(Charity)* Rapids in South River upstream from Philpott Reservoir *on private land;* Precambrian-Paleozoic Alligator Back gneiss and phyllite (Espenshade and others, 1975)
Petersburg, City of	112	Appomattox River Falls *(Petersburg)* Rapids in Appomattox River at "fall zone"visible from US1 and 301 bridge; Paleozoic Petersburg granite (Milici and others, 1963)
Pittsylvania	113	White Oak Mountain *(Mount Hermon, Spring Garden)* Prominent linear mountain crossed by SH41; Triassic Dry Fork and Pine Hall sandstone and mudstone (Henika and Thayer, 1977; 1983)
	114	Gap of Smith Mountain *(Smith Mountain Dam)* Deeply incised watergap of Roanoke River in Smith Mountain with hydroelectric dam impounding Smith Mountain Lake; Precambrian-Paleozoic Candler phyllite (Conley, 1985)
Prince William	(48)	Thoroughfare Gap *(see Fauquier County)*
Pulaski	(88)	Big Falls *(see Montgomery County)*
	115	Draper Mountain overlook *(Pulaski)* Panoramic view from Draper Mountain along

County/City	No.	Name/*(Topographic Map)*/Description
		USH11; Silurian sandstone and quartzites (Cooper, 1961)
Rappahannock	116	Big Devil Stairs *(Chester Gap, Washington)* Rocky ravine of Rush River tributary with waterfall by fire road and trail between SNPMP 17 and 18; Precambrian-Cambrian Catoctin metabasalt and Precambrian Pedlar granodiorite (Gathright, 1976)
	117	Chester Gap *(Chester Gap)* Windgap in Blue Ridge crossed by USH522; Precambrian-Cambrian Catoctin metabasalt (Rader and Webb, 1979)
	118	Hazel River Falls *(Thornton Gap)* Waterfall of Hazel River by fire road and trail between SNPMP33 and 34; Precambrian Pedlar granodiorite (Gathright, 1976)
	119	Little Devil Stairs *(Bentonville, Thornton Gap)* Rocky ravine of Keyser Run with waterfall by fire road and trail between SNPMP19 and 20; Precambrian-Cambrian metabasalt (Gathright, 1976)
	(102)	Marys Rock *(see Page County)*
	(106)	Thornton Gap *(see Page County)*
Richmond, City of	120	James River Falls *(Richmond, Bon Air)* Rapids in James River (Figure 14) at "fall zone" visible from James River Park; Paleozoic Petersburg granite (Daniels and Onuschak, 1974; Goodwin, 1980)
Roanoke	121	Dixie Caverns *(Glenvar)* Commercial cavern adjacent to USI81, Exit 39; Cambrian Elbrook dolomite (Holsinger,1975)

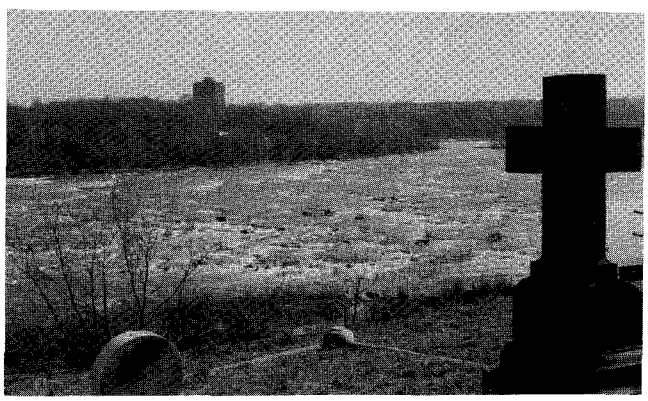

Figure 14. James River Falls.

	122	Cove Mountain *(Glenvar)* Mountain in JNF with rocky overlook, "Dragons Tooth", by Appalachian Trail from SR624; Silurian sandstones and quartzites at the apex of a syncline (Milici and others, 1963)
	123	Hanging Rock *(Salem)* Rocky pinnacle at Green Mountain windgap by SH419; Silurian quartzites and sandstones (Amato, 1974)
	(54)	Murray Gap *(see Franklin County)*
	(26)	Roanoke River watergap *(see Bedford County)*
Rockbridge	124	Balcony Falls *(Snowden)* Rapids in James River at west entrance to watergap in Blue Ridge Mountains; Cambrian Harpers quartzite (Brown and Spencer, 1981)
	125	Big House and Little House Mountains *(Collierstown)* Elongate mountains connected by a saddle; by *trail over private land* from SR635; Silurian Tuscarora and Clinton sandstone and shale with lower slopes of Ordovician Martinsburg shale (Kozak, 1965)
	126	Cypress Falls *(Cornwall)* Waterfall of Sheep Creek at junction with South River visible from SR608; Cambrian Conococheague limestone, dolomite, and sandstone (Bick, 1960)
	127	Devils Marble Yard *(Snowden)* Talus deposit on Blue Ridge Mountain foothill by JNF Belfast Trail from SR781; Cambrian Antietam sandstone and quartzite (Brown and Spencer, 1981)
	128	Gibbs Falls *(Brownsburg)* Waterfall *on private land* and near SR604; Ordovician Beekmantown cherty dolomite with limestone (Bick, 1960)
	(10)	Humphreys Gap *(see Amherst County)*
	(11)	James River gorge *(see Amherst County)*
	129	Goshen Pass *(Goshen)* Sinuous watergap of Maury River traversed by SH39; Silurian Clinton and Tuscarora sandstone, quartzite and shale (Bick, 1960)
	130	Natural Bridge *(Natural Bridge)* See detailed description on page 22
	(22)	Panther Gap *(see Bath County)*
	131	Wigwam Falls *(Montebello)* Waterfall of about 30′ on Wigwam Creek tributary between BRPMP34 and 35 by trail from Yankee Horse Parking Area; Precambrian Pedlar granodiorite (Werner, 1966)
Rockingham	132	Cedar Falls *(Elkton East)* Waterfall of Wolf Run *on private land* near SR623; Precambrian-Cambrian Catoctin metabasalt (Brent, 1960)
	133	Chimney Rock *(Timberville)* Vertical rock unit at Brocks Gap watergap in Little North Mountain adjacent to SH259; Devonian Ridgely sandstone (Brent, 1960)
	134	Dry Run Falls *(Elkton East)* Waterfall of Dry Run near fire road from between SNPMP62 and 63; Precambrian-Cambrian metabasalt (Gathright, 1976)
	135	Endless Caverns *(Tenth Legion)* Commercial cavern in Massanutten Mountain by SR793; Ordovician Beekmantown limestone (Brent, 1960; Holsinger, 1975)
	136	High Knob overlook *(Brandywine)* Shenandoah Mountain overlook by GWNFR85 from USH33; Mississippian Pocono sandstone (Brent, 1960)
	137	Massanutten Caverns *(Harrisonburg)* Commercial cavern adjacent to Massanutten Mountain by SR685; Ordovician Beekmantown limestone (Gathright and Frischmann, 1986)
	138	Massanutten Peak *(Harrisonburg)* Prominent peak on southwest end of Massanutten Mountain with rocky cliffs visible from USH 33; Silurian Massanutten sandstone and quartzite (Gathright and Frischmann, 1986)
	139	Mole Hill *(Bridgewater)* Conical shaped hill visible from USH33; Tertiary intrusive volcanic basalt (Gathright and Frischmann, 1986)
	140	Round Hill *(Bridgewater)* Conical shaped hill adjacent to SR727 at Bridgewater; Ordovician Beekmantown cherty dolomite with limestone (Gathright and Frischmann, 1986)
	(66)	Swift Run Gap *(see Greene County)*
Russell	141	Beartown Mountain *(Elk Garden)* Prominent mountain adjacent to Clinch Mountain visible from USH19; Silurian sandstone and quartzite (Milici and others, 1963)
	142	Big Falls *(Lebanon)* Waterfall of Big Cedar Creek flowing over Cambrian Nolichucky

County/City	No.	Name/*(Topographic Map)*/Description
		limestone and sandstone (Cooper, 1945)
	143	Sinkhole Valley *(Carbo)* Linear valley with numerous sinkholes and no surface drainage traversed by SR600; Mississippian Greenbrier limestone in syncline (personal communication, N. H. Evans, 1988)
	144	Tank Hollow Falls *(Carbo)* Waterfall *on private land* of tributary to Clinch River near Cleveland; Cambrian Honaker limestone (personal communication, N. H. Evans, 1988)
Scott	145	Big Branch Falls *(Clinchport)* Waterfall on Big Branch adjacent to SR618; Cambrian Copper Ridge dolomite (Brent, 1963)
	146	Hilton Gap *(Hilton)* Watergap of Hilton Creek through Pine Ridge with USH58 and 421; Mississippian Price and Devonian Brallier sandstone, siltstone and shale (Milici and others, 1963)
	147	Little Stony Creek gorge *(Coeburn, Dungannon)* Rocky sinuous gorge with two waterfalls of about 100′ total drop on Little Stony Creek by trail from JNFR 700 and SR664; Pennsylvanian Lee Formation sandstone and shale (personal communication, N. H. Evans, 1988)
	148	Moccasin Gap *(Gate City)* Watergap of Moccasin Creek in Clinch Mountain traversed by USH 23, 58 and 421; Silurian and Ordovician sandstones (Milici and others, 1963)
	149	Natural Tunnel *(Clinchport)* See detailed description on page 23
Shenandoah	150	Big Sloss *(Wolf Gap)* Rocky pinnacle on North Mountain by SR 675 and GWNF trail; Silurian Tuscarora quartzite (Young and Rader, 1974)
	151	Fort Valley *(Strasburg)* Mountain enclosed valley of Passage Creek with prominent watergap traversed by SR678; valley with Devonian sandstone and shale with surrounding mountains with Silurian Massanutten sandstone and quartzite (Rader and Biggs, 1976)
	(104)	New Market Gap *(see Page County)*
	152	Seven Bends *(Toms Brook)* Sinuous river channel of North Fork of Shenandoah River visible from Powell Mountain overlook in GWNF by SR758 and trail; Ordovician shales with sandstones (Hack and Young, 1959; Rader and Biggs, 1976)
	153	Shenandoah Caverns *(New Market)* Commercial cavern by SR730; Cambrian Conococheague limestone and dolomite (Holsinger, 1975)
	(161)	Signal Knob *(see Warren County)*
Smyth	154	Whitetop Mountain *(Whitetop Mountain)* Third highest mountain in State (5520′) by JNFR89 from SR600; Precambrian Mt. Rogers rhyolite (Rankin and others, 1972)
	(62)	Mt. Rogers *(see Grayson County)*
Stafford	155	Rappahannock River Falls *(Fredericksburg)* Rapids of Rappahannock River at "fall zone" visible from USH1 bridge; Paleozoic Fredericksburg Complex granite, schist, and gneiss (Pavlides, 1980)
Suffolk, City of	(38)	Dismal Swamp *(see Chesapeake City)*
Tazewell	156	Burkes Garden *(Garden Mountain, Hutchinson Rock, Cove Creek)* Mountain rimmed valley drained by Burkes Garden Creek through "The Gap" watergap and reached by SR623; eroded dome with Ordovician limestones rimmed by Silurian and Ordovician sandstone and shale (Cooper, 1944)
Virginia Beach, City of	157	Back Bay *(North Bay, Knotts Island)* Large bay bounded by sand ridge on east and tidal swamps on west with numerous islands; Quaternary fluvial, swamp, marsh, and beach deposits (Berquist and others, in preparation)
	158	The Desert *(Cape Henry)* Sand dunes to 30′ high at Seashore State Park adjacent to USH60; Quaternary swamp, fluvial, and beach deposits (Berquist and others, in preparation)
Warren	(117)	Chester Gap *(see Rappahannock County)*
	159	Greasy Falls *(Bentonville)* Waterfall on Greasy Run in Shenandoah National Park; Precambrian Pedlar granodiorite (Gathright, 1976)
	(47)	Manassas Gap *(see Fauquier County)*
	(105)	Overall Run Falls *(see Page County)*
	160	Shenandoah River *(Front Royal)* Confluence of North and South Forks of Shenandoah River at Front Royal; Ordovician limestone and dolomite (Rader and Biggs, 1975)
	161	Signal Knob *(Strasburg)* Prominent mountain summit with GWNF trail from SR678 used during Civil War as observation post; Silurian Massanutten sandstone and quartzite (Rader and Biggs, 1976)
	162	Skyline Caverns *(Front Royal)* Commercial cavern adjacent to USH340; Ordovician Rockdale Run limestone (Holsinger, 1975, Rader and Biggs, 1975)
Washington	163	Abrams Falls *(Mendota)* Waterfall *on private land* of about 80′ on Abrams Creek; Mississippian Pennington sandstone and shale (Averitt, 1941)
	164	Brumley Creek Falls *(Brumley)* Waterfall on Brumley Creek by SR690 and trail in Hidden Valley State Wildlife Management Area; Silurian sandstone and quartzite (Milici and others, 1963)
	165	Garrett Creek Falls *(Brumley)* Waterfall on Garrett Creek adjacent to SR611; Mississippian limestone and sandstone (Milici and others, 1963)
	166	Moccasin Gap *(Brumley)* Watergap (Figure 15) of Little Moccasin Creek in Clinch Mountain by USH19; Silurian and Ordovician sandstone and shale (Milici and others, 1963)
	167	Straight Branch gorge *(Konnarock)* Sinuous gorge of Straight Branch with many cascades and USH 58; Cambrian Erwin, Hampton and Unicoi quartzites, sandstones and shales (Rankin and others, 1972)

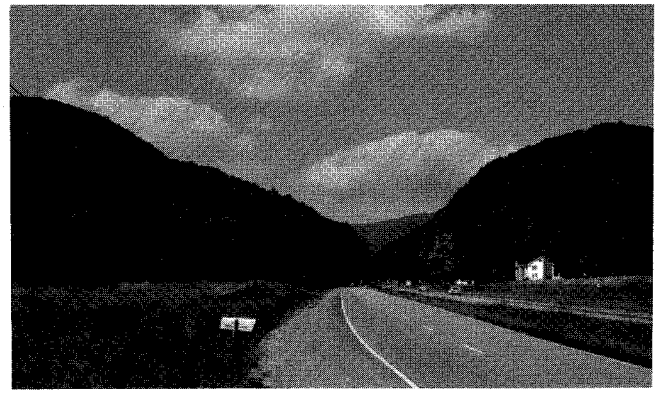

Figure 15. Moccasin Gap.

County/City	No.	Name/*(Topographic Map)*/Description
	168	Tumbling Creek *(Saltville)* Narrow gorge of Tumbling Creek with many cascades by SR747 in Clinch Mountain State Wildlife Management Area; Silurian sandstone and quartzite (Milici and others, 1963)
	(154)	Whitetop Mountain *(see Smyth County)*
Westmoreland	169	Horsehead Cliffs *(Stratford Hall)* Cliffs of about 150′ along the Potomac River adjacent to Westmoreland State Park; Tertiary Chesapeake Group sands and clays (Berquist and others, in preparation)
Wise	170	Big Stone Gap *(Appalachia)* Watergap of Powell River between Stone and Little Stone Mountains by USH23; Mississippian and Pennsylvanian sandstones, shales, and limestones (Nolde and others, 1988)
	171	Guest River gorge *(Coeburn)* Narrow gorge of Guest River with Interstate Railroad; Pennsylvanian Lee sandstone, conglomerate and shale (personal communication T. M. Gathright, II, 1988)
	172	High Knob overlook *(Norton)* Mountain peak in Jefferson National Forest with panoramic view of Powell Valley and Appalachian Plateau by SR619 and JNFR238; Mississippian Bluestone sandstone and shale (Nolde and others, 1986)
	173	Little Stone Gap overlook *(Norton)* Panoramic view of Powell Valley from SR610; Mississippian Hinton sandstone and shale (Nolde and others, 1986)
	174	Pound Gap *(Jenkins West)* Windgap in Pine Mountain crossed by USH23; Pennsylvanian Lee sandstone in fault contact with Mississippian Pennington sandstone and shale (Rice, 1973)
Wythe	(61)	Comers Rock Overlook *(see Grayson County)*
	175	Fosters Falls *(Foster Falls)* Rapids in New River at watergap between Fosters Falls and Hematite mountains visible from SR608; Cambrian Erwin quartzite (Stose and Stose, 1957)
York	176	Cornwallis Cave *(Yorktown)* A room-size cave adjacent to the York River at Yorktown; Tertiary Yorktown coquina (Johnson, 1972)

REFERENCES CITED

Allen, R. M., Jr., 1967, Geology and mineral resources of Page County: Virginia Division of Mineral Resources Bulletin 81, 78 p.

Alvord, D. C., and Miller, R. L., 1972, Geologic map of the Elkhorn City quadrangle, Ky-Va: U. S. Geological Survey Geologic Quadrangle GQ-951.

Amato, R. V., 1974, Geology of the Salem quadrangle, Virginia: Virginia Division of Mineral Resources Report of Investigation 37, 40 p.

Averitt, Paul, 1941, The Early Grove gas field, Scott and Washington counties, Virginia: Virginia Geological Survey Bulletin 56, 50 p.

Bartholomew, M. J., 1977, Geology of the Greenfield and Sherando quadrangles, Virginia: Virginia Division of Mineral Resources Publication 4, 43 p.

_____ 1981, Geology of the Roanoke and Stewartsville quadrangles: Virginia Division of Mineral Resources Publication 34, 23 p.

Berquist, C. R., Mixon, R. B., and Newell, W. L., in preparation, Geologic map of the Coastal Plain, Virginia: Virginia Division of Mineral Resources.

Bick, K. F., 1960, Geology of the Lexington quadrangle, Virginia: Virginia Division of Mineral Resources Report of Investigation 1, 40 p.

_____ 1962, Geology of the Williamsville quadrangle, Virginia: Virginia Division of Mineral Resources Report of Investigation 2, 40 p.

Biggs, T. H., 1974, Geographic and cultural names of Virginia: Virginia Division of Mineral Resources Information Circular 20, 374 p.

Bird, S. O., 1985, Eden in peril: the troubled waters of the Chesapeake Bay: Virginia Division of Mineral Resources Publication 56, 27 p.

Bloomer, R. O., and Werner, H. J., 1955, The Blue Ridge region in central Virginia: Geological Society of America Bulletin, v. 66, p. 579-606.

Brent, W. B., 1960, Geology and mineral resources of Rockingham County: Virginia Division of Mineral Resources Bulletin 76, 174 p.

_____ 1963, Geology of the Clinchport quadrangle, Virginia: Virginia Division of Mineral Resources Report of Investigation 5, 46 p.

Brown, C. E., and Spencer, E. W., 1981, Geologic map of the James River Face Wilderness, Bedford and Rockbridge counties, Virginia: U. S. Geological Survey Miscellaneous Field Studies Map MF-1337A.

Brown, W. R., 1958, Geology and mineral resources of the Lynchburg quadrangle, Virginia: Virginia Division of Mineral Resources Bulletin 74, 99 p.

_____ 1969, Geology of the Dillwyn quadrangle: Virginia Division of Mineral Resources Report of Investigation 10, 77 p.

Butts, Charles, and Edmundson, R. S., 1966, Geology and mineral resources of Frederick County: Virginia Division of Mineral Resources Bulletin 80, 142 p.

Cooper, B. N., 1944, Geology and mineral resources of the Burkes Garden quadrangle, Virginia: Virginia Geological Survey Bulletin 60, 299 p.

_____ 1945, Industrial limestones and dolomites in Virginia: Clinch Valley district: Virginia Geological Survey Bulletin 66, 259 p.

_____ 1961, Grand Appalachian field excursion: Virginia Polytechnic Institute Engineering Extension Series, Geological Guidebook No. 1, 187 p.

Conley, J. F., 1985, Geology of the southwestern Virginia Piedmont: Virginia Division of Mineral Resources Publication 59.

Daniels, P. A., Jr., and Onuschak, Emil, Jr., 1974, Geology of the Studley, Yellow Tavern, Richmond and Seven Pines quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigation 38, 75 p.

Dietrich, R. V., 1959, Geology and mineral resources of Floyd County of the Blue Ridge Upland, Southwestern Virginia: Bulletin Virginia Polytechnic Institute Engineering Experiment Station Series n. 134, 160 p.

———1970, Geology and Virginia: The University Press of Virginia: Charlottesville, VA, 213 p.

Englund, K. J., 1964, Geology of the Middlesboro South quadrangle Tennessee, Kentucky, Virginia: U. S. Geological Survey Geologic Quadrangle GQ-301.

Ern, E. H., 1968, Geology of the Buckingham quadrangle, Virginia: Virginia Division of Mineral Resources Report of Investigation 15, 45 p.

Espenshade, G. H., Rankin, D. W., Shaw, K. W., and Neuman, R. B., 1975, Geologic map of the east half of the Winston-Salem quadrangle, North Carolina - Virginia: U. S. Geological Survey Miscellaneous Geologic Investigation Map I-709-B.

Frye, Keith, 1986, Roadside geology of Virginia: Mountain Press Publishing Company, Missoula, MT, 278 p.

Gathright, T. M., II, 1976, Geology of the Shenandoah National Park: Virginia Division of Mineral Resources Bulletin 86, 93 p.

Gathright, T. M., II, Henika, W. S., and Sullivan, J. L., III, 1977, Geology of the Waynesboro East and Waynesboro West quadrangles, Virginia: Virginia Division of Mineral Resources Publication 3, 53 p.

Gathright, T. M., II, Henika, W. S., and Sullivan, J. L., III, 1978a, Geology of the Grottoes quadrangle, Virginia: Virginia Division of Mineral Resources Publication 10, one sheet.

Gathright, T. M., II, Henika, W. S., and Sullivan, J. L., III, 1978b, Geology of the Crimora quadrangle, Virginia: Virginia Division of Mineral Resources Publication 13, one sheet.

Gathright, T. M., II, and Frischmann, R. S., 1986, Geology of the Harrisonburg and Bridgewater quadrangles, Virginia: Virginia Division of Mineral Resources Publication 60, 21 p.

Gathright, T. M., II, and Nystrom, P. G., Jr., 1974, Geology of the Ashby Gap quadrangle, Virginia: Virginia Division of Mineral Resources Report of Investigation 36, 55 p.

Goodwin, B. K., 1980, Geology of the Bon Air quadrangle, Virginia: Virginia Division of Mineral Resources Publication 18, one sheet.

Hack, J. T., and Durloo, L. H., Jr., 1962 (revised 1977) Geology of Luray Caverns: Virginia Division of Mineral Resources Report of Investigation 3, 43 p.

Hack, J. T., and Young, R. S., 1959, Intrenched meanders of the North Fork of the Shenandoah River, Virginia: U. S. Geological Survey Professional Paper 354-A, 10 p.

Henika, W. S., and Thayer, P. A., 1977, Geology of the Blairs, Mount Hermon, Danville and Ringgold quadrangles: Virginia Division of Mineral Resources Publication 2, 45 p.

———1983, Geologic map of the Spring Garden quadrangle: Virginia Division of Mineral Resources Publication 48, one sheet.

Holsinger, J. R., 1975, Descriptions of Virginia caves: Virginia Division of Mineral Resources Bulletin 85, 450 p.

Johnson, G. H., 1972, Geology of the Yorktown, Poquoson West and Poquoson East quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigation 30, 57 p.

Kozak, S. J., 1965, Geology of the Millboro quadrangle, Virginia: Virginia Division of Mineral Resources Report of Investigation 8, 19 p.

Lee, K. Y., 1980, Triassic and Jurassic geology of the southern part of the Culpeper Basin and the Barboursville Basin, Virginia: U. S. Geological Survey Open-file Report 80-468, 9 p.

Lesure, F. G., 1957, Geology of the Clifton Forge Iron district: Bulletin Virginia Polytechnic Institute Engineering Experiment Station Series 118, 130 p.

———1982, Geologic map of Ramseys Draft addition, Augusta and Highland counties, Virginia: U. S. Geological Survey Miscellaneous Field Studies MF 1369-A, one sheet.

Lukert, M. T., III, and Nuckols, E. B., II, 1976, Geology of the Linden and Flint Hill quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigation 44, 83 p.

Marr, J. D., Jr., 1980, Geology of the Willis Mountain quadrangle: Virginia Division of Mineral Resources Publication 25, one sheet.

McGuire, O. S., 1970, Geology of the Eagle Rock, Strom, Oriskany, and Salisbury quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigation 24, 39 p.

Milici, R. C., Spiker, C. T., Jr., and Wilson, J. M., 1963, Geologic map of Virginia: Virginia Division of Mineral Resources.

Miller, R. L., and Brosge, W. P., 1954, Geology and oil resources of the Jonesville District Lee County, Virginia: U. S. Geological Survey Bulletin 990, 240 p.

Miller, R. L., and Roen, J. B., 1973, Geologic map of the Pennington Gap quadrangle, Lee County, Virginia and Harlan County, Kentucky: U. S. Geological Survey Geologic Quadrangle GQ-1098.

Mixon, R. B., 1985, Stratigraphic and geomorphic

framework of uppermost Cenozoic deposits in the southern Delmarva Peninsula, Virginia and Maryland: U. S. Geological Survey Professional Paper 1067-G, 53 p.

Nelson, W. A., 1962, Geology and mineral resources of Albemarle County: Virginia Division of Mineral Resources Bulletin 77, 92 p.

Nolde, J. E., Henderson, J. A., Jr., and Miller, R. L., 1988, Geology of the Virginia portion of the Appalachia and Benham quadrangles: Virginia Division of Mineral Resources Publication 72, one sheet.

Nolde, J. E., Lovett, J. A., Whitlock, W. W. and Miller, R. L., 1986, Geology of the Norton quadrangle, Virginia: Virginia Division of Mineral Resources Publication 65, one sheet.

Oaks, R. Q., Jr., and Coch, N. K., 1973, Post-Miocene stratigraphy and morphology, southeastern Virginia: Virginia Division of Mineral Resources Bulletin 82, 135 p.

Parker, P. E., 1968, Geologic investigation of the Lincoln and Bluemont quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigation 14, 23 p.

Pavlides, Louis, 1980, Revised nomenclature and stratigraphic relationships of the Fredericksburg Complex and Quantico Formation of the Virginia Piedmont: U. S. Geological Survey Professional Paper 1146, 29 p.

Rader, E. K., 1967, Geology of the Staunton, Churchville, Greenville, and Stuarts Draft quadrangles: Virginia Division of Mineral Resources Report of Investigation 12, 43 p.

_____ 1969, Geology of the Stokesville and Parnassus quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigation 19, 30 p.

Rader, E. K., and Biggs, T. H., 1975, Geology of the Front Royal quadrangle, Virginia: Virginia Division of Mineral Resources Report of Investigation 40, 91 p.

_____ 1976, Geology of the Strasburg and Toms Brook quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigation 45, 104 p.

Rader, E. K. and Gathright, T. M., II, 1984, Stratigraphy and structure in the thermal springs area of the western anticlines: Sixteenth Virginia Geologic Field Conference, Guidebook, 58 p.

_____ 1986, Stratigraphic and structural features of Fincastle Valley and Eagle Rock Gorge, Botetourt County, Virginia, in Southeastern Section of the Geological Society of America: Geological Society of America Centennial Field Guide Volume 6, p. 106-108.

Rader, E. K., Gathright, T. M., II, and Marr, J. D., Jr., 1986, Trimble Knob basalt diatreme and associated dikes, Highland County, Virginia, in Southeastern Section of the Geological Society of America: Geological Society of America Centennial Field Guide Volume 6, p. 97-100.

Rader, E. K., and Webb, H. W., 1979, Geologic factors affecting land modification, Warren County, Virginia: Virginia Division of Mineral Resources Publication 15, one sheet.

Rankin, D. W., Espenshade, G. H., and Neuman, R. B., 1972, Geologic map of the west half of the Winston-Salem quadrangle, North Carolina, Virginia and Tennessee: U. S. Geological Survey Miscellaneous Geological Investigation Map I-709-A.

Reed, J. C., Jr., 1969, Ancient lavas in Shenandoah National Park near Luray, Virginia: U. S. Geological Survey Bulletin 1265, 43 p.

Reed, J. C., Jr., Sigafoos, R. S., and Fisher, G. W., 1980, The geologic story of Great Falls and the Potomac River gorge: U. S. Geological Survey Bulletin 1471, 75 p.

Rice, C. L., 1973, Geologic map of the Jenkins West quadrangle Kentucky, Virginia: U. S. Geological Survey Geologic Quadrangle GQ 1126.

Schultz, A. P., Stanley, C. B., Gathright, T. M., II, Rader, E. K., Bartholomew, M. J., Lewis, S. E., and Evans, N. H., 1986, Geologic map of Giles County: Virginia Division of Mineral Resources Publication 69, one sheet.

Sharp, H. S., 1936, The origin of Mountain Lake, Virginia, in Contributions to Virginia geology: Virginia Geological Survey Bulletin 46, p. 79-84.

Spencer, E. W., 1968, Geology of the Natural Bridge, Sugarloaf Mountain, Buchanan, and Arnold Valley quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigation 13, 55 p.

_____ 1985, Natural Bridge and Natural Bridge Caverns: Lexington, Virginia, Poorhouse Mountain Studies, 48 p.

Stose, A. J., and Stose, G. W., 1957, Geology and mineral resources of the Gossan Lead district and adjacent areas in Virginia: Virginia Division of Mineral Resources Bulletin 72, 233 p.

Waag, Charles, 1964, Geologic map Douthat State Park: Virginia Division of Mineral Resources Unpublished Field Map.

Werner, H. J., 1966, Geology of the Vesuvius quadrangle, Virginia: Virginia Division of Mineral Resources Report of Investigation 7, 53 p.

Wissinger, Kathleen and Carter, Dennis, 1986, Park Guide: Luray, The Shenandoah Natural History Association, 36 p.

Young, R. S., and Rader, E. K., 1974, Geology of the Woodstock, Wolf Gap, Conicville, and Edinburg quadrangles, Virginia: Virginia Division of Mineral Resources Report of Investigation 35, 69 p.

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RICHARD SCOTT MITCHELL[1]

January 28, 1929 - July 31, 1988

Born in Colorado, raised in Nebraska and graduated with three degrees from the University of Michigan, Richard Scott Mitchell arrived at the University in 1953, just 24 years old, to assume his appointment as assistant professor in the Department of Geology. Thus began the longest tenure in the history of that department and its successor, the Department of Environmental Sciences. He was promoted to Professor in 1963, and served as acting chairman of the Department of Geology from 1964 until 1969, shortly before the formation of the new department.

From the outset, Dick's teaching focused on mineralogy and petrology, the two major subjects that he taught for 35 years; they were the foundation courses for all majors in geology. His love of these subjects and his committment to the students was famous, and many graduate students chose research problems in mineralogy and petrology or in related fields because of Dick's knowledge and insight, and his contagious enthusiasm for the subject. You could count on one hand the number of classes Dick had to miss during his entire career at the University. To study under Dick was to know a superb mineralogist and a dedicated teacher who set high standards for his students as well as for himself.

Dick's early research, began at Michigan, involved the X-ray analysis of silicon carbide crystals and the study of polytypism and screw dislocations in those and similar minerals. His landmark studies on polytypism continued in the 1970's and included many papers written with various collaborators - from students at the University to established foreign crystallographers. Owing to this seminal work, Dick gained an international reputation in polytypsim and dislocations. Arising from this was an ongoing study of metamict minerals, those minerals whose internal structure has been disrupted by the radioactive decay of uranium or thorium in the crystal lattice. He published numerous papers as well as a definitive summary on metamicts in 1973. A third research focus, perhaps of special interest to us, was the mineralogy and petrology of Virginia. Throughout his lifetime at the University, in his teaching, in his research and in his spare time, he was unceasingly hunting for, analyzing and reporting on minerals found in Virginia - discovering previously unreported minerals, relocating earlier mineral localities, and describing the crystallographic properties of these mineral discoveries.

Midway in his career he ventured into studying trace elements in coal ash and their potential hazard to the environment. More recently, with members of the Department of Environmental Sciences and the Virginia Division of Mineral Resources, he had been investigating mineralization in American and European caves.

Partly because of his geological background, but more likely due to his natural bent, Richard Mitchell was a historian interested in the origin and derivation of things. A life-long corner of his profession was his interest in the evolution of mineralogical names. For over ten years Dick served as one of the three executive editors for "Rocks and Minerals", a journal in which his column "Who's Who in Mineral Names" appeared in each issue. In 1979, this interest in the origin and meaning of mineral names was expanded into a book entitled "Mineral Names: What Do They Mean?", the first such book in nearly 100 years. Three years ago his "Dictionary of Rocks" was published, a volume listing and defining more than 4,000 rocks. One of his last works "Minerals of Albemarle County, Virginia" is being prepared for publication by the Division of Mineral Resources.

[1]Taken from the Memorial Resolution for Richard Scott Mitchell, Faculty of Arts and Sciences of theUniveristy of Virginia, September 27, 1988.